in place of C. A. Eggert, Ph. D., who resigned at the close of the last session. W. H. Kirk, Ph. D., of Johns Hopkins University, has been elected instructor in Latin in the place of Frank E. Bradshaw, M. A., who died last month.

A new school of technology is to be established at Hartford, as a department of Trinity College.

The University of the State of New York has published a Bulletin on Extension of University Teaching in England and America, by Dr. James E. Russell. In July, 1893, on recommendation of some of the leading members of convocation, the regents appointed Prof. James E. Russell, then of New York but now professor of pedagogy in the University of Colorado, a special commissioner to visit European educational institutions and report on whatever he might find of most importance to educational institutions in New York, and the results of his investigations are embodied in the present report.

Dr. B. E. Fernow has been appointed special lecturer on forests and forestry in the school of economics, political science and history, in the University of Wisconsin. This course of lectures will probably be the first one of the kind to be given in a school of this character. The following may be mentioned among the topics of which Dr. Fernow will treat: The state of natural resources, the nature of the forest and of its products; an idea as to what forests are, how they grow, how their materials enter into human use, the forest influences on climate, water and soil conditions; history and statistics; methods and requirements of forest management; forest yield a financial calculation; principles of forest legislation, with special reference to the United States, including the history of the forestry reform movement.

CORRESPONDENCE.

THE PERCEPTION OF DIRECTION.

The 'inverted image' discussion in Science suggests a number of questions that have a bearing on the pertinence and validity of purely physical solutions of the problem under consideration.

Have we a special sense of direction; and if so, to what extent can its indications be trusted without constant supervision and correction by the other senses? Can the range of the lines drawn from particular cones of the retina to the lens be determined by this hypothetical sense of direction to give any accurate notion of their real projections in space? Does the short base line from the cones to the lens remain constant in its indications under the conditions presented in the movements of the eye to secure the best adjustment for distinct vision? Would not any slight variations in this base line, resulting from movements of the eye, give a confused outline of distant objects if there were no other means of correcting the impressions received from them? Without further detail of specific inquiry the whole may be summarized in general terms, can a satisfactory solution of biological problems be obtained by an appeal to purely physical or chemical considerations?

From our present knowledge of physiological processes, it must be admitted that the physical conditions under which the impressions are made on the retina by external objects represent but a single factor in the series of complex biological activities involved in our final interpretation of visual sensations. The mutuality or reciprocity of the special senses in their relations to the cerebrum must be recognized as essential factors in the conclusions arrived at as to the real significance of the impressions received by the peripheral elements of the special sense organs.

The inverted images on the retina are evidently not directly concerned in the judgments we form in regard to the position and characteristics of the external objects that produce them. These peripheral images on the retina are telegraphed, as it were, to the central nerve organs of vision and brought into relation with cerebral activities, in connection with impressions transmitted in like manner from other sense organs to their appropriate nerve centers, and the resulting correlation of these complex interdependent processes are the basis of the judgments we habitually form in regard to the nature and position of objects in the field of vision.

That we have no specific physiological sense

of direction is manifest in the unconscious tendency to curve to the right or left in walking when blindfolded. My experiments with forty-nine young men show (*Nature* XXXII., 293; SCIENCE XV., 14) that this divergence from a right line is not owing to differences in the length, or strength, or dexterity of the legs, the physical factors that suggest a convenient explanation of the phenomena, but to a lack of coördination in the muscles of the legs, arising from the defective supervision of their movements by the senses.

The ability to walk in a given direction and the proper interpretation of the inverted image on the retina are alike determined by the activities of the brain, including the central sense organs, and physical considerations relating solely to the peripheral organs concerned, which take into the account but a single factor in a complex problem, cannot be accepted as furnishing satisfactory explanations of physiological processes.

MANLY MILES.

LANSING, MICH., November 27.

SCIENTIFIC LITERATURE.

Elements of the Mathematical Theory of Electricity and Magnetism. By J. J. THOMSON. Cambridge University Press. New York, Macmillan & Co. 1895. Crown 8°. Pp. vi. 510.

Electricity and Magnetism. A Mathematical Treatise for Advanced Undergraduate Students. By FRANCIS A. NIPHER. St. Louis, John L. Boland Book and Stationery Co. 1895. Crown 8°. Pp. xi. 426.

Prof. J. J. Thomson is well known as the worthy successor to the chair of Maxwell and Lord Rayleigh. He has been hitherto known chiefly for his work in mathematical physics, and latterly for his numerous experimental researches. This book exhibits him in a new light, namely, as a teacher of elementary students, and plainly declares him a master in that domain. The subject of 'Electricity and Magnetism' is one that lends itself readily to applications of many of the most difficult portions of analysis, and it is generally supposed that an exact comprehension of the various essential parts of the theory is only to be attained by those persons who possess a thorough mathematical training. Maxwell's great work is a bugbear to many a student on account of the mathematical difficulties which it undoubtedly contains. How mistaken the idea is that the essentials of the theory cannot be presented to a person of but slight mathematical training, a perusal of this delightful book will show. The reviewer often recalls the words of one of his old professors in college, who was wont to ask the student who had successfully deduced some differential equation to 'translate that into English.' Prof. Thomson's book consists in doing exactly this for the whole theory of Electricity and Magnetism. In this respect it marks almost a new departure in text-books, for while we are familiar with books which, by leaving out difficulties, and by the use of the process known in England as 'Calculus-dodging,' attempt to attain simplicity, we have never before come across a treatment at the same time so full, so clear and exact, of this particular subject. There are, to be sure, two examples of this style of book. If one were asked to name the best English treatise on Thermodynamics he would still have to answer, Maxwell's 'Theory of Heat.' And yet Maxwell's 'Heat' contains very few mathematical symbols. Still if one thoroughly understands the essential principles contained in the book, and has a thorough knowledge of mathematics, he will be well able to write the mathematical treatment for himself. A second example is Maxwell's 'Elementary Treatise on Electricity,' of which we are at once reminded by the present work. Maxwell, however, there treated but a small portion of the subject, principally electrostatics. What Maxwell would have written had he lived to the present day, and treated of Magnetism and the Electromagnetic Field in general, would have probably resembled what Prof. Thomson has given us. This is perhaps a sufficient compliment, but we are tempted to use the trite illustration of the 'flower from the crannied wall,' and say that if one fully comprehended the 'all in all' of this book, he would be possessed of what is worth knowing of the modern theory of electricity, and with the help of a sufficient knowledge of Green's Theorem and the properties of definite integrals he could spin it out into two thick volumes of mathe-